Review Article

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Ophthalmology Section

Dry Eye Disease and Screen Exposure in School Children: Is There a Link?

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ABSTRACT

Dry Eye Disease (DED) is characterised by tear film instability, which can cause ocular surface damage. Patients with dry eye illness may have ocular pain/discomfort as well as visual abnormalities, which can have a significant influence on quality of life. Increased usage of digital displays for work, communication, and leisure, particularly during pandemics, may exacerbate dry eye. The duration of smartphone use was also found to be longer in school children suffering from DED than in those without. A frequently recognised concept for the association between digital screen use and dry eye illness is that it alters blinking dynamics, resulting in ocular dryness. The present study discusses evidence that digital screen usage is linked to dry eye illness, that digital device use modifies blinking dynamics, and that dry eye impacts mental health and workplace productivity in digital screen users. People who use digital screens can benefit from effective DED prevention and management strategies.

Keywords: Digital screen, Dry eye disease, Ocular health, Quality of life, School going children

INTRODUCTION

The DED is an ocular surface disease characterised by tear film instability and inflammation, both of which can cause damage to the eye [1]. The prevalence of dry eye in the population varies greatly, ranging from 5% to 50%, which is most likely owing to different definitions of DED [2]. Dry eye symptoms vary in intensity across people and might include ocular irritation, pain, weariness, and visual abnormalities such as fluctuating and blurred vision [1,3,4]. Dry eye irritation and pain are known to reduce quality of life and may have an influence on mental health [2,5,6]. Visual disturbances along with discomfort might interfere with tasks like reading and driving [2,7,8]. Furthermore, dry eye can reduce job productivity, which has implications for both personal achievement and the economy [9,10].

Given the potentially detrimental consequences of dry eye, it is critical to understand the variables that influence its development. The aetiology of dry eye is difficult to define since it can be caused by a variety of reasons. Intrinsic risk factors for DED include advanced age, female gender, ocular illnesses, and certain underlying systemic and immunological disorders [2]. Extrinsic risk factors for DED may include contact lens usage, environmental circumstances (for example, low humidity or airflow on the eye), topical or systemic drugs, lack of hygiene habits for eyelids and eyelashes, eye beauty trends, and eye cosmetic product contents and applications [2,11,12].

Digital screen use (for example, on a computer, laptop, tablet, or smartphone) is considered to contribute to dry eye development by changing blinking dynamics [2,13]. A meta-analysis estimated the incidence of DED in workers who use digital displays to be between 9.5% to 87.5% [14]. Because personal devices such as smartphones & computers are so widely used today, digital screen use is especially important [3,15]. A recent research of 9 to 10-year-old children, for example, discovered that children spent an average of 3.8 hours per day using screens (for TV, video, video-game playing, texting, chatting, and social media), with virtually all children reporting using screens on a regular basis [16].

Education is one field that has evolved to fit quickly changing government regulations. According to United Nations Educational, Scientific and Cultural Organization (UNESCO), public health initiatives to battle the virus affected over 365 million pupils worldwide. Schools in Asia were closed for approximately 40 weeks as well as replaced with online learning to continue learning [17]. These changes in online education have resulted in greater exposure time to the digital gadgets used by schoolchildren, which has a deleterious influence on the ocular surface leading to dry eye [18-20].

The incidence of dry eye symptoms among schoolchildren has grown over the last two decades presumably due to increasing screen exposure when engaging with the internet and social media [21,22]. Prolonged screen use can produce dry eye symptoms by reducing blink rates and evaporating the ocular surface [22,23]. The ensuing symptoms, such as dryness, irritation, soreness, eye tiredness, and impaired vision, might interfere with school activities [24]. Furthermore, the Tear Film and Ocular Surface Society (TFOS) released the Dry Eye Workshop II (DEWS II) Epidemiology report, emphasising the importance of conducting studies in school children or younger populations, which may have a relatively high prevalence, to evaluate the potential risk factors, especially the use of digital screens [2].

So far, prevalence and risk factors for dry eye symptoms in schoolchildren have been documented in China [22], Japan [25], and Mexico [26]. The findings of these studies on well-known risk variables such as gender and contact lens usage were inconsistent. Furthermore, smoking and perceived stress are being investigated as potential contributors to dry eye symptoms [27]. As a result, it is still required to determine the prevalence and risk factors for dry eye symptoms among schoolchildren. Therefore, the present review focuses on the ocular health and its association with the screen exposure among the school going children.

Search Methodology

A MEDLINE/PubMed search of databases was performed to evaluate the literature on DED and digital screen use. The key search phrases employed were “dry eye,” “visual display,” “blink,” “digital screen,” and “screen use” in various combinations. Articles were reviewed and included in a narrative review if the information was relevant to discussing the relationship between dry eye along with digital screen use, the relationship between dry eye as well as blinking dynamics, the impact of dry eye on digital screen users’ quality of life, or dry eye preventative strategies.

Link between Prolonged Screen Time and Dry Eye Symptoms among School Children

The inevitable increase in youth digital media use presents a new challenge of ocular disorders and digital eyestrain at a young age. Children's access to and ownership of mobile devices (such as smartphones and tablets) has increased significantly during the last decade [28]. Children utilise mobile devices for more than just education & academics; they play games, watch movies, chat, take photographs, and access apps. According to Common Sense Media's countrywide poll, 95% of children aged 0 to 8 years used a mobile device in 2017, with 42% owning their own tablet device. Children aged eight and younger spend an average of two hours and 19 minutes a day with screen media [29]. A study of children aged 9-11 years from 12 nations found that 54.2% surpassed the recommended screen time limitations (≤2 hours per day). Concerns have been raised about the excessive use of digital media and the impact it has on children's health and well-being [30].

Increased and continuous exposure to visual display devices like computer screens, laptops, tablets, and smartphones for various activities has resulted in a greater frequency of dry eye in adults, with an estimated prevalence of over 50% among those who use gadgets for extended periods of time [31]. However, DED is frequently underestimated or missed in children, or it is attributed to other reasons such as ocular allergies or as a result of inflammatory and autoimmune aetiologies such as juvenile rheumatoid arthritis and Sjögren syndrome. Several studies suggest a 6%-10% incidence of dry eye among school-aged children, which is linked to increased smartphone use time [28]. Bernard JY et al., recently observed a 33% prevalence of dry eye in 60 apparently healthy youngsters aged 7 to 17 years, which they attributed to increasing screen use [32]. Schiffman RM et al., found that teenagers with longer daily smartphone usage were more likely to have various ocular complaints [33]. Each extra half-hour of digital screen use elevated the risk of moderate-to-severe DED by approximately double [34]. During the COVID-19 epidemic, a research in Saudi Arabia found that children who used screens for ≥6 hours per day had a considerably greater risk of DED (almost 75%) [35]. There has been reported prevalences varying widely, depending on the population and the symptom scale used, studies in school or university populations have commonly report that a substantial minority often between ~20% and >50% experiences at least some dry-eye symptoms, and the longer screen durations have been associated with higher symptom burden [36,37]. The underlying mechanism is attributed to decreased blink rate along with increased tear evaporation while digital device use, resulting in tear film instability and ocular surface disruption [20].

Alterations in Blinking Behaviour Associated with Digital Device Use

The most common explanation for explaining the relationship between digital screen usage and dry eye is that digital screen use affects blinking dynamics by decreasing both blink rate and blink completeness, resulting in increased ocular surface dryness [37]. Aqueous tears evaporate from the tear film between blinks, therefore complete blinking is necessary to refill the tear film by dispersing tears (from lacrimal glands) and lipids (from meibomian glands) throughout the ocular surface. Thus, decreased and incomplete blinking causes ocular surface dryness by allowing for higher evaporative loss, which may, over time, trigger the DED cycle. Interestingly, people with dry eyes blink more frequently than people without dry eyes, possibly to compensate for tear film instability [38].

Blink rates were observed to be lower when reading tasks on digital devices than at rest. When individuals performed active tasks on a computer, like playing computer or video games, their blink rate decreased compared to resting settings [39]. Cardona G et al., discovered that when participants played a computer game instead of a rest condition, their blink rate decreased by roughly 42%. When the participants stopped playing the computer game, their blink rates reverted to normal [40]. Blink rate was also discovered to decrease during an active computer work (arranging text in alphabetical order) contrasted to the blink rate obtained while participants were engaged in relaxed discussion. In addition to decreased blink rates, active digital screen tasks increase the percentage of incomplete blinks. Kim AD et al., discovered that while playing video games, the percentage of incomplete blinks rose when compared to the baseline. Specifically, 80% of blinks were unfinished in the baseline condition, while 92% and 88% of blinks were unfinished while playing video games. These findings also support the concept that digital screen use may cause dry eye due to its influence on blinking dynamics [39].

Impact of Dry Eye Disease (DED) on School Children

Moon JH et al., conducted the first study to establish the link between the use of smartphones as well as Video Display Terminals (VDTs) to the development of dry eyes. In a study of 288 Korean children, researchers discovered that the length of smartphone usage and total daily VDT use were connected with an elevated risk of DED [20,39]. In a subsequent study on 916 children aged 7-12 years from both urban and rural areas, Moon JH et al., further discovered that the mean daily duration of smartphone use was considerably greater in the DED group when compared to the normal group, along with prolonged smartphone use was a strong risk factor for paediatric DED [20].

Similar findings were observed in research by Rojas-Carabali W et al., who examined ocular surface features and test results in a healthy paediatric population aged 7 to 17 years [34]. The study found that all individuals utilised screens on a daily basis, with an average of 5.59±2.77 hours. According to the Dry Eye Workshop (DEWS) II Diagnostic Methodology report published by the Tear Film and Ocular Surface Society (TFOS), they discovered that all participants had at least one abnormal ocular surface test result, and 33.33% had a DED diagnosis, which they linked to device use [40,41]. Choi JH et al., found that subjects who used a smartphone for more than four hours had higher subjective Computer Vision Syndrome (CVS) scores (fatigue, burning, along with dryness) and total OSDI scores than the computer display group [42].

Smartphones are used at low viewing distances due to their tiny Light-Emitting Diode (LED) screens, which cause ocular fatigue, glare, & discomfort [39]. Uchino M et al., discovered that VDT workers had a shorter TBUT and higher corneal fluorescence staining despite normal lacrimal function [10]. Decreased blink rate and increased interpalpebral ocular region while using VDTs may enhance tear evaporation owing to tear film destabilisation, resulting in DED [9]. Moon JH et al., also found that discontinuing smartphone use for four weeks in children with DED resulted in significant reductions in noninvasive TBUT, punctate epithelial erosion, as well as OSDI scores, with all affected children no longer categorised as DED sufferers at the end of the abstinence period [20]. Moon JH et al., similarly observed a higher prevalence of DED in older children, reporting rates of 9.1% in grades 4-6 compared to 4% in grades 1-3. This increased risk was attributed to greater smartphone use and longer daily exposure to Visual Display Terminals (VDTs) among older students [20].

Desktop and laptop computer screens are generally viewed in horizontal gaze, therefore the palpebral aperture is larger than for traditional book reading, which is typically done in downgaze. As a result, a greater portion of the ocular surface is exposed to the effects of tear film evaporation. Furthermore, VDTs and Liquid Crystal Display (LCD) tablet displays are illuminated, create glare, and may contain micro screen flickers, making it more difficult for eyes to focus. When focusing on a backlit screen, the blink rate decreases and partial blinking increases, resulting in tear film instability, dry eyes, and visual fatigue [10]. Incomplete blinking, in which the upper eyelid does not cover the full ocular surface, can lead to increased evaporation and tear film breakup due to insufficient tear film distribution and reduced tear film thickness in the inferior cornea. This may be more relevant to dry eye than the absolute blink rate since tear film stability can be maintained with a lower blink rate as long as most blinks are complete [28].

Patient Symptoms and Reported Outcomes

Children and adolescents who spend extended periods of time using digital devices frequently report a recurring cluster of symptoms known as Digital Eye Strain (DES) or CVS. These complaints are usually classified into two categories: internal/visual stress symptoms (eye/visual fatigue, aching around the eyes, intermittent blurred vision, difficulty refocusing, and headache) and external/ocular-surface symptoms (dryness, burning, foreign body/gritty sensation, photophobia, tearing, and redness) [43]. Symptom intensity and prevalence in children and adolescents have been linked to increased reported daily screen time and higher scores on validated symptom questionnaires [29]. School and clinic-based surveys show dose-response relationships: more daily screen usage and longer uninterrupted viewing times are related with higher symptom assessments as well as objective indicators like shorter tear-breakup time or altered blink metrics [44]. Recent paediatric research have found significant rates of at least one dry-eye or asthenopic symptom in cohorts with heavy device usage, and population evaluations confirm that pre-adolescents and adolescents are not immune to DES [45].

To analyse patient-reported symptoms, researchers often use validated questionnaires that quantify the frequency, severity, and functional effect of ocular problems. The Ocular Surface Disease Index (OSDI), a 12-item assessment with a score of 0 to 100, is one of the most regularly used tools for assessing ocular-surface pain and visual function, and it has been utilised with proper adaption in teenage populations [46]. Shorter instruments, such as the DEQ-5 (5 questions) and SPEED (8 items), are preferable for fast assessments of dry-eye symptoms. For screen-related visual disorders, the Computer Vision Syndrome Questionnaire (CVS-Q) enables a more specific examination of digital device-associated symptoms, as well as a recently validated CVS-Q teen version improves applicability for adolescents aged 12 to 17 years [47].

The symptom scale chosen should be appropriate for the study's goal, whether it is focussing on ocular surface illness or device-related visual strain [48]. In paediatric studies, investigators frequently combine these questionnaires with a brief screen-use log (daily hours, duration of continuous use, device type, viewing distance) and objective examinations such as tear breakup time, Schirmer testing, blink-rate analysis, or accommodative along with vergence assessment, as subjective symptoms do not always correlate perfectly with clinical signs [48].

Clinical Implications

Children and adolescents who use digital devices for an extended period of time are at a high risk of developing symptomatic tear-film malfunction and visual discomfort, which can have an impact on reading tolerance, classroom performance, and overall visual comfort [43]. According to multiple recent reviews and epidemiologic studies, the symptom complex known as DES or CVS in young people includes both visual-stress complaints (eye/visual fatigue, intermittent blur, difficulty refocusing, as well as headache) and ocular-surface symptoms (dryness, burning, gritty/foreign-body sensation, photophobia, tearing, and redness). These symptoms are more common with increased daily screen use and longer uninterrupted viewing periods [49-51].

The paediatric presentation is characterised by evaporative dysfunction: prolonged exposure to near screens lowers spontaneous blink rate and increases incomplete blinking, which promotes tear-film breakage and causes focal ocular surface desiccation [52]. At the same time, sustained accommodative and vergence demand (e.g., poor working distance, suboptimal lighting, or small font sizes) causes internal asthenopia symptoms; because tear-film instability along with binocular/accommodative stress frequently co-exist; many children experience both dry-eye and visual-fatigue symptoms. The pathophysiologic linkages between blinking behaviour, tear-film instability, and asthenopia have been clearly shown in recent research [49].

Prevention of Dry Eye Disease (DED) due to Digital Screening

Dry eye caused by digital screens, particularly in children and teenagers, has been a rising problem as the usage of smartphones, tablets, and laptops has increased. One of the key preventative tactics is to promote the 20-20-20 rule, which encourages users to gaze 20 feet away for 20 seconds for every 20 minutes of screen use [53]. This approach reduces continuous accommodating stress and enables tear film redistribution. Additionally, keeping an optimum screen distance (approximately 18-24 inches) and ergonomic placement to keep displays at or slightly below eye level might assist reduce ocular surface exposure and tear film evaporation [54].

Environmental modifications are also important in prevention. Maintaining proper indoor humidity, minimising direct exposure to air conditioning or fans, and promoting regular conscious blinking while using a screen can all help keep your eyes hydrated [55]. Limiting screen usage, particularly among school-going children, and arranging screen-free intervals are critical behavioural changes. For individuals who are already experiencing minor symptoms, artificial tears or eye lubricating solutions may help. For persistent or serious cases, examination for meibomian gland dysfunction and focused eyelid cleanliness, warm compresses, or referral to an ophthalmologist for further evaluation are recommended [36]. Educational initiatives for families and schools (planned outside breaks, classroom flashing reminders) are effective public-health tactics [56]. Educating parents, care takers, and teachers about these preventative practices can play a critical role for reducing the long-term influence of digital displays on the ocular health of children.

CONCLUSION(S)

It was shown that over 90% of youngsters aged 9 to 14 years experienced dry eye symptoms while utilising electronics for schooling or other purposes. A cumulative exposure length of more than 3-3.5 hours per day greatly increases the risk of ocular surface disturbance. Children who increased their computer usage by half an hour each day were more likely to experience moderate to severe dry eyes. Parents, teachers, and politicians should seek to limit screen usage to less than three hours per day and promote a rule of 20/20/20 rule. Children should be encouraged to take regular breaks, such as walking away from their screens for at least 10 minutes per hour. Using a simple timer or software application to switch off the screen at regular intervals can aid in improving the child memory.

REFERENCES

[1] Craig JP, Nichols KK, Akpek EK, Caffery B, Dua HS, Joo CK, et al. TFOS DEWS II Definition and Classification Report. Ocul Surf. 2017;15(3):276-83. Doi: 10.1016/j.jtos.2017.05.008.

[2] Stapleton F, Alves M, Bunya VY, Jalbert I, Lekhanont K, Malet F, et al. TFOS DEWS II Epidemiology Report. Ocul Surf. 2017;15(3):334-65. Doi: 10.1016/j.jtos.2017.05.003.

[3] Clayton JA. Dry Eye. N Engl J Med. 2018;378(23):2212-23. Doi: 10.1056/NEJMc1808906.

[4] Kawashima M, Yamatsuji M, Yokoi N, Fukui M, Ichihashi Y, Kato H, et al. Screening of dry eye disease in visual display terminal workers during occupational health examinations: The Moriguchi study. J Occup Health. 2015;57(3):253-58. Doi: 10.1539/joh.14-0243-OA.

[5] Ahn JM, Lee SH, Rim TH, Park RJ, Yang HS, Kim TI, et al; Epidemiologic Survey Committee of the Korean Ophthalmological Society. Prevalence of and risk factors associated with dry eye: The Korea National Health and Nutrition Examination Survey 2010-2011. Am J Ophthalmol. 2014;158(6):1205-1214.e7. Doi: 10.1016/j.ajo.2014.08.021.

[6] Paulsen AJ, Cruickshanks KJ, Fischer ME, Huang GH, Klein BE, Klein R, et al. Dry eye in the Beaver Dam Offspring Study: Prevalence, risk factors, and health-related quality of life. Am J Ophthalmol. 2014;157(4):799-806. Doi: 10.1016/j.ajo.2013.12.023.

[7] Karakus S, Mathews PM, Agrawal D, Henrich C, Ramulu PY, Akpek EK. Impact of dry eye on prolonged reading. Optom Vis Sci. 2018;95(12):1105-13. Doi: 10.1097/OPX.0000000000001303.

[8] Mathews PM, Ramulu PY, Swenor BS, Utine CA, Rubin GS, Akpek EK. Functional impairment of reading in patients with dry eye. Br J Ophthalmol. 2017;101(4):481-86. Doi: 10.1136/bjophthalmol-2015-308237.

[9] Nichols KK, Bacharach J, Holland E, Kislan T, Shettle L, Lunacsek O, et al. Impact of dry eye disease on work productivity, and patients' satisfaction with over-the-counter dry eye treatments. Invest Ophthalmol Vis Sci. 2016;57(7):2975-82. Doi: 10.1167/iovs.16-19419.

[10] Uchino M, Uchino Y, Dogru M, Kawashima M, Yokoi N, Komuro A, et al. Dry eye disease and work productivity loss in visual display users: The Osaka Study. Am J Ophthalmol. 2014;157(2):294-300. Doi: 10.1016/j.ajo.2013.10.014.

[11] Gomes JAP, Azar DT, Baudouin C, Efron N, Hirayama M, Horwath-Winter J, et al. TFOS DEWS II iatrogenic report. Ocul Surf. 2017;15(3):511-38. Doi: 10.1016/j.jtos.2017.05.004.

[12] Jones L, Downie LE, Korb D, Benitez-Del-Castillo JM, Dana R, Deng SX, et al. TFOS DEWS II management and therapy report. Ocul Surf. 2017;15(3):575-628. Doi: 10.1016/j.jtos.2017.05.006.

[13] LeBlanc AG, Gunnell KE, Prince SA, Saunders TJ, Barnes JD, Chaput J-P. The ubiquity of the screen: An overview of the risks and benefits of screen time in our modern world. Transl J Am Sports Med. 2017;2(17):104-13.

[14] Courtin R, Pereira B, Naughton G, Chamoux A, Chiambaretta F, Lanhers C, et al. Prevalence of dry eye disease in visual display terminal workers: A systematic review and meta-analysis. BMJ Open. 2016;6(1):e009675. Doi: 10.1136/bmjopen-2015-009675.

[15] Sheppard AL, Wolffsohn JS. Digital eye strain: Prevalence, measurement and amelioration. BMJ Open Ophthalmol. 2018;3(1):e000146. Doi: 10.1136/bmjophth- 2018-000146.

[16] Walsh JJ, Barnes JD, Tremblay MS, Chaput J-P. Associations between duration and type of electronic screen use and cognition in US children. Comput Human Behav. 2020;108:106312. Doi: 10.1016/j.chb.2020.106312.

[17] The United Nations Education, Scientific and Cultural Organization. From disruption to recovery 2020. Available from: https://en.unesco.org/covid19/educationresponse.

[18] Chidi-Egboka NC, Jalbert I, Wagner P, Golebiowski B. Blinking and normal ocular surface in school-aged children and the effects of age and screen time. Br J Ophthalmol. 2023;107(11):1613-20. Doi: 10.1136/bjo-2022-321645.

[19] Uzun SL, Topcu H. The relationship of distance learning with ocular surface disorders in students in the COVID-19 pandemic. Int Ophthalmol. 2022;42(10):3045-51. Doi: 10.1007/s10792-022-02290-w.

[20] Moon JH, Kim KW, Moon NJ. Smartphone use is a risk factor for pediatric dry eye disease according to region and age: A case control study. BMC Ophthalmol. 2016;16(1):188. Doi: 10.1186/s12886-016-0364-4.

[21] Hung N, Kang EY, Lee TW, Chen TH, Shyu YC, Sun CC. The risks of corneal surface damage in aqueous-deficient dry eye disease: A 17-year population-based study in Taiwan. Am J Ophthalmol. 2021;227:231-39.

[22] Zhang Y, Chen H, Wu X. Prevalence and risk factors associated with dry eye syndrome among senior high school students in a county of Shandong Province, China. Ophthalmic Epidemiol. 2012;19(4):226-30. Doi: 10.3109/09286586.2012.670742 .

[23] Wang MTM, Tien L, Han A, Lee JM, Kim D, Markoulli M, et al. Impact of blinking on ocular surface and tear film parameters. Ocul Surf. 2018;16(4):424-29. Doi: 10.1016/j.jtos.2018.06.001.

[24] Al-Mohtaseb Z, Schachter S, Shen Lee B, Garlich J, Trattler W. The relationship between dry eye disease and digital screen use. Clin Ophthalmol. 2021;15:3811-20. Doi: 10.2147/OPTH.S321591.

[25] Ayaki M, Kawashima M, Uchino M, Tsubota K, Negishi K. Gender differences in adolescent dry eye disease: A health problem in girls. Int J Ophthalmol. 2018;11(2):301-07. Doi: 10.18240/ijo.2018.02.20.

[26] Uchino M, Dogru M, Uchino Y, Fukagawa K, Shimmura S, Takebayashi T, et al. Japan Ministry of Health study on prevalence of dry eye disease among Japanese high school students. Am J Ophthalmol. 2008;146(6):925-929e2. Doi: 10.1016/j.ajo.2008.06.030.

[27] Garza-Leon M, Lopez-Chavez E, De La Parra-Colin P. Prevalence of ocular surface disease symptoms in high school students in Monterrey, Mexico. J Pediatr Ophthalmol Strabismus. 2021;58(5):287-91. Doi: 10.3928/01913913-20210308-01.

[28] Tonkerdmongkol D, Poyomtip T, Poolsanam C, Watcharapalakorn A, Tawonkasiwattanakun P. Prevalence and associated factors for self-reported symptoms of dry eye among Thai school children during the COVID-19 outbreak. PLoS One. 2023;18(4):e0284928. Doi: 10.1371/journal.pone.0284928.

[29] Jadeja JN, Shroff KV, Shah A, Pandey A, Dubey S. Association of digital device usage and dry eye disease in school children. Indian J Ophthalmol. 2024;72(7):1031-36. Doi: 10.4103/IJO.IJO_703_23.

[30] Ichhpujani P, Singh RB, Foulsham W, Thakur S, Lamba AS. Visual implications of digital device usage in school children: A cross-sectional study. BMC Ophthalmol. 2019;19(1):76. Doi: 10.1186/s12886-019-1082-5.

[31] Rideout V, Saphir M, Robb M, Phan U. Zero to eight: Children's media use in America 2017. Common Sense Media. Available from: https://www.commonsensemedia.org/research/zero-to-eight-childrens-media-use-inamerica-2017.

[32] Bernard JY, Padmapriya N, Chen B, Cai S, Tan KH, Yap F, et al. Predictors of screen viewing time in young Singaporean children: The GUSTO cohort. Int J Behav Nutr Phys Act. 2017;14(1):112. Doi: 10.1186/s12966-017-0562-3.

[33] Schiffman RM, Christianson MD, Jacobsen G, Hirsch JD, Reis BL. Reliability and validity of the ocular surface disease index. Arch Ophthalmol. 2000;118(5):615-21. Doi: 10.1001/archopht.118.5.615.

[34] Rojas-Carabali W, Uribe-Reina P, Muñoz-Ortiz J, Terreros-Dorado JP, Ruiz-Botero ME, Torres-Arias N, et al. High prevalence of abnormal ocular surface tests in a healthy pediatric population. Clin Ophthalmol. 2020;14:3427-38. Doi: 10.2147/OPTH.S266261.

[35] Muntz A, Turnbull PR, Kim AD, Gokul A, Wong D, Tsay TS, et al. Extended screen time and dry eye in youth. Cont Lens Anterior Eye. 2022;45(5):101541. Doi: 10.1016/j.clae.2021.101541.

[36] Wróbel-Dudzińska D, Osial N, Stępień PW, Gorecka A, Żarnowski T. Prevalence of Dry Eye Symptoms and Associated Risk Factors among University Students in Poland. Int J Environ Res Public Health. 2023;20(2):1313. Doi: 10.3390/ijerph20021313.

[37] Alnahdi W, Hadrawi M, Danish E, Alghamdi A, Taher N, Alfaraidi AT, et al. Relationship between screen time and dry eye symptoms during the COVID-19 pandemic in the pediatric population of the Western Region of Saudi Arabia. Cureus. 2022;14(11):e31015.

[38] Uchino M, Yokoi N, Uchino Y, Dogru M, Kawashima M, Komuro A, et al. Prevalence of dry eye disease and its risk factors in visual display terminal users: The Osaka Study. Am J Ophthalmol. 2013;156(4):759-66. Doi: 10.1016/j.ajo.2013.05.040.

[39] Kim AD, Muntz A, Lee J, Wang MTM, Craig JP. Therapeutic benefits of blinking exercises in dry eye disease. Cont Lens Anterior Eye. 2021;44(3):101329.

[40] Cardona G, Garcia C, Seres C, Vilaseca M, Gispets J. Blink rate, blink amplitude, and tear film integrity during dynamic visual display terminal tasks. Curr Eye Res. 2011;36(3):190-97. Doi: 10.3109/02713683.2010.544442.

[41] Argiles M, Cardona G, Perez-Cabre E, Rodriguez M. Blink rate and incomplete blinks in six different controlled hard-copy and electronic reading conditions. Invest Ophthalmol Vis Sci. 2015;56(11):6679-85. Doi: 10.1167/iovs.15-16967.

[42] Choi JH, Li Y, Kim SH, Jin R, Kim YH, Choi W, et al. The influences of smartphone use on the status of the tear film and ocular surface. PLoS One. 2018;13:e0206541. Doi: 10.1371/journal.pone.0206541.

[43] Kaur K, Gurnani B, Nayak S, Deori N, Kaur S, Jethani J, et al. Digital eye strain-a comprehensive review. Ophthalmol Ther. 2022;11(5):1655-80. Doi: 10.1007/s40123-022-00540-9.

[44] Gupta PC, Rana M, Ratti M, Duggal M, Agarwal A, Khurana S, et al. Association of screen time, quality of sleep and dry eye in college-going women of Northern India. Indian J Ophthalmol. 2022;70(1):51-58. Doi: 10.4103/ijo.IJO_1691_21.

[45] Mohan A, Sen P, Shah C, Jain E, Jain S. Prevalence and risk factor assessment of digital eye strain among children using online e-learning during the COVID-19 pandemic: Digital eye strain among kids (DESK study-1). Indian J Ophthalmol. 2021;69(1):140-44. Doi: 10.4103/ijo.IJO_2535_20.

[46] Dougherty BE, Nichols JJ, Nichols KK. Rasch analysis of the Ocular Surface Disease Index (OSDI). Invest Ophthalmol Vis Sci. 2011;52(12):8630-35. Doi: 10.1167/iovs.11-8027.

[47] Pucker AD, Kerr AM, Sanderson J, Lievens C. Digital eye strain: Updated perspectives. Clin Optom (Auckl). 2024;16:233-46. Doi: 10.2147/OPTO.S412382.

[48] Iqbal M, Elmassry A, Elgharieb M, Said O, Saeed A, Ibrahim T, et al. Visual, ocular surface, and extraocular diagnostic criteria for determining the prevalence of computer vision syndrome: A cross-sectional smart-survey-based study. Med Hypothesis Discov Innov Ophthalmol. 2024;13(1):01-15. Doi: 10.51329/mehdiophthal1489.

[49] Kaur K, Gurnani B, Nayak S, Deori N, Kaur S, Jethani J, et al. Digital eye strain-A comprehensive review. Ophthalmol Ther. 2022;11(5):1655-80. Doi: 10.1007/s40123-022-00540-9

[50] Kahal F, Al Darra A, Torbey A. Computer vision syndrome: A comprehensive literature review. Future Sci OA. 2025;11(1):2476923. Doi: 10.1080/20565623.2025.2476923.

[51] Albasheer O, Jareebi MA, Alnami RM, Soweedi AM, Alqahtani SS, Ageel AM, et al. Computer vision syndrome among Saudi University students: A cross-sectional analysis of risks and discipline variations. Healthcare (Basel). 2025;13(21):2798. Doi: 10.3390/healthcare13212798.

[52] Hirota M, Uozato H, Kawamorita T, Shibata Y, Yamamoto S. Effect of incomplete blinking on tear film stability. Optom Vis Sci. 2013;90(7):650-57. Doi: 10.1097/OPX.0b013e31829962ec.

[53] Park JS, Choi MJ, Ma JE, Moon JH, Moon HJ. Influence of cellular phone videos and games on dry eye syndromes in University Students. J Korean Acad Community Health Nurs. 2014;25(1):12-23.

[54] Fujita H, Sano K, Baba T, Tanaka T, Ohno-Matsui K. Blind working time in visual display terminal users. J Occup Health. 2019;61(2):175-81. Doi: 10.1002/1348-9585.12027.

[55] Byber K, Radtke T, Norbäck D, Hitzke C, Imo D, Schwenkglenks M, et al. Humidification of indoor air for preventing or reducing dryness symptoms or upper respiratory infections in educational settings and at the workplace. Cochrane Database Syst Rev. 2021;12(12):CD012219. Doi: 10.1002/14651858.CD012219.pub2.

[56] Marshev V, Bolloc'h J, Pallamin N, de Bougrenet de la Tocnaye J-L, Cochener B, Nourrit V. Impact of virtual reality headset use on eye blinking and lipid layer thickness. J Fr Ophtalmol. 2021;44(7):1029-37. Doi: 10.1016/j.jfo.2020.09.032.

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